Unit	Lesson	Lesson Objectives
Atomic Structure and the Periodic Table		
	The Historical Development of Atomic Theory	
		Describe early atomic models including Dalton's postulates.
		Describe how Rutherford's gold foil experiment led to Rutherford's nuclear model of the atom.
		Describe how Thomson's and Millikan's research led to the understanding of the electron in the early atomic model.
		Science Practice: Describe, in writing, how a scientist's creativity resulted in changes in atomic theory.
	The Modern Atomic Theory	
		Describe the experimental basis for Einstein's explanation of the photoelectric effect.
		Describe the modern (electron cloud) model of the atom.
		Explain Bohr's model of the atom and how it accounts for the existence of spectral lines.
		Science Practice: Compare Dalton's atomic model with the current quantum model of the atom.
	The Structure of the Atom	
		Describe the structure of atoms, and discriminate between the relative sizes and electrical charges of protons, neutrons, and electrons.
		Explain that protons and neutrons have substructures and consist of particles called quarks.
		Explain the relationship between the number of neutrons in an atom of an element, its mass number, and its isotopes.
		Identify an element based on the number of protons in an atom.
		Science Practice: Use math to calculate the average atomic mass of an element from its isotopic composition.
	Elements, Compounds, and Mixtures	
		Describe compounds as pure substances.
		Describe elements as pure substances.
		Describe mixtures.
		Science Practice: Classify matter as pure substances or mixtures by studying their properties.
	Atomic Numbers and Electron Configurations	
		Express the arrangement of electrons of atoms using electron configurations.
		Identify electron configurations as a scientific model, and explain its usefulness and limitations.
		Use atomic orbitals to write quantum numbers for electrons.
		Science Practice: Use specific symbols to represent the arrangement of electrons in atoms.
	The History and Arrangement of the Periodic Table	
		Describe the arrangement of the periodic table and relate the properties of atoms to their position in the periodic table.
		Outline the historical development of the periodic table.
		Use the periodic table to classify elements.
		Science Practice: Predict the properties of elements based on their position on the periodic table.
	Electrons and the Periodic Table	
		Relate the position of an element in the periodic table to its electron configuration.
		Use the periodic table to determine the number of valence electrons available for bonding.
		Science Practice: Analyze the relationship between electron configurations and the structure of the periodic table.

Unit	Lesson	Lesson Objectives
	Periodic Trends	
		Use the periodic table to identify and explain periodic trends in ionization energy.
		Use the periodic table to identify trends in electronegativity and electron affinity.
		Use the periodic table to predict trends in atomic radii and ionic radii.
		Science Practice: Given two elements, make predictions that compare their radii, ionization energy, electronegativity, and/or electron affinity.
States and Changes of Matter		
	Gases	
		Describe how kinetic-molecular theory explains the properties of gases, including temperature, pressure, compressibility, and volume.
		Describe the postulates of kinetic-molecular theory.
		Interpret the behavior of ideal gases in terms of kinetic-molecular theory, including diffusion and effusion.
		Science Practice: Identify the limitations of kinetic-molecular theory.
	Liquids	
		Describe how kinetic-molecular theory explains the properties of liquids, including compressibility and shape.
		Describe how the postulates of kinetic-molecular theory apply to liquids.
		Science Practice: Use the kinetic-molecular theory model to explain the behavior of liquids.
	Solids and Plasmas	
		Describe how kinetic-molecular theory explains the properties of plasmas.
		Describe how kinetic-molecular theory explains the properties of solids, including compressibility, shape, and volume.
		Use kinetic-molecular theory to compare and contrast atomic or molecular motion in solids and plasmas.
		Science Practice: Give examples of plasmas in nature and technology.
	Phase Changes	
		Describe phase changes in terms of kinetic-molecular theory.
		Describe the energy changes that happen during changes of state.
		Science Practice: Make and interpret graphs of temperature vs. time for changes of state.
	Changes in Matter	
		Differentiate between extensive and intensive properties of matter, and give examples of each.
		Differentiate between physical changes and chemical changes of matter.
		Differentiate between physical properties and chemical properties of matter.
		Science Practice: Identify substances based on their chemical and physical properties.
	Lab: Physical and Chemical Changes	
		Conduct systematic observations during an experiment.
		Describe indicators of chemical change.
		Distinguish between chemical changes and physical changes.
		Science Practice: Write a clear, coherent laboratory report that describes methods used and conclusions made.

Unit	Lesson	Lesson Objectives
Chemical Bonding		
	Ionic Bonding	
		Describe how polyatomic ions form ionic bonds with other ions.
		Explain how ionic bonds affect the properties of ionic compounds.
		Explain how ionic bonds form.
		Explain that ionic compounds form crystal lattices.
		Science Practice: Explain the process by which ionic bonds form.
	Covalent Bonding	
		Construct electron-dot structures (i.e., Lewis structures) to illustrate the arrangement of electrons in covalent structures.
		Explain how covalent bonds affect the properties of covalent compounds.
		Use the octet rule to predict covalent compounds.
		Use the periodic table to determine the number of electrons available for bonding.
		Science Practice: Develop and use electron-dot models, and explain their usefulness and limitations.
	Lab: Ionic and Covalent Bonds	
		Design and conduct an experiment to test the properties of substances.
		Draw conclusions about the type of bond in a substance based on the tested properties of that substance.
		Science Practice: Compare your conclusions about the identity of the bonds in substances to published information about those substances.
	Molecular Geometry	
		Predict molecular structure using the Valence Shell Electron Pair Repulsion (VSEPR) theory.
		Use the hybridization model to predict molecular geometry.
		Science Practice: Predict the shape of simple molecules using the VSEPR theory and Lewis structures.
	Intermolecular Forces	
		Describe how hydrogen bonding and van der Waals forces affect the volatility, boiling points, and melting points of liquids and solids.
		Describe hydrogen bonding.
		Describe van der Waals forces, including dipole-dipole forces and London dispersion forces.
		Science Practice: Give examples of intermolecular forces occurring in nature.
Chemical Reactions and Stoichiometry		
	Writing and Balancing Chemical Equations	
		Describe chemical reactions by writing word equations and formula equations.
		Use the law of conservation of mass to balance chemical equations.
		Science Practice: Identify and use special symbols properly in chemical equations.
	Types of Chemical Reactions	
		Distinguish among the types of chemical reactions.
		Predict the product of each type of chemical reaction.

Unit	Lesson	Lesson Objectives
	Lab: Types of Reactions	
		Identify the reactants and products of a reaction performed in a laboratory setting.
		Write balanced equations for a reaction performed in a laboratory setting.
		Science Practice: Use experimental data to classify a reaction.
	Molar Masses	
		Define a mole and explain its role in the measurement of matter.
		Determine the molar mass of a molecule from its chemical formula.
		Explain the relationship between the mole and Avogadro's number.
		Science Practice: Perform math calculations to determine the number of particles in a given sample of a substance.
	Percent Composition and Molecular Formula	
		Determine the empirical formula and the molecular formula of a substance through calculations.
		Explain the relationship between the empirical formula and the molecular formula of a compound.
		Solve problems to calculate percent composition.
		Science Practice: Use math to solve percent composition problems and to determine empirical and molecular formulas.
	Introduction to Stoichiometry	
		Perform stoichiometric calculations to determine the mole-to-mole relationships between reactants and products of a reaction.
		Use a balanced equation to write mole ratios correctly to use in stoichiometry problems.
		Science Practice: Use mathematical procedures, including dimensional analysis and significant figures, when solving mole-to-mole stoichiometry problems.
	Stoichiometric Calculations	
		Identify and solve stoichiometric problems that relate mass to moles and mass to mass.
		Perform stoichiometric calculations to determine mass relationships between reactants and products of a reaction.
		Use molar mass to write conversion factors that convert between mass and moles.
		Science Practice: Use mathematical procedures, including dimensional analysis and significant figures, when solving mole-to-mass, mass-to-mole, and mass-to-mass stoichiometric problems.
	Limiting Reactant and Percent Yield	
		Calculate the percent yield of a reaction.
		Identify the limiting and excess reactants for a given reaction.
		Use the limiting reactant to predict the theoretical yield of a reaction.
		Science Practice: Use mathematical procedures, including dimensional analysis and significant figures, when solving limiting reactant and percent yield stoichiometry problems.
	Lab: Limiting Reactant and Percent Yield	
		Calculate the percent yield for a given reaction.
		Calculate the theoretical yield for a given reaction.
		Identify the limiting and excess reactants for a given reaction.
		Science Practice: Identify and explain sources of error in an experiment.

Unit	Lesson	Lesson Objectives
The Gas Laws		
	Gas Laws	
		Apply Dalton’s law of partial pressures to describe the composition of gases.
		Define partial pressure.
		Derive the combined gas law from Boyle’s law, Charles’s law, and Gay-Lussac’s law.
		State Boyle’s law, Charles’s law, and Gay-Lussac’s law, and apply these laws to calculate the relationships among volume, temperature, and pressure.
		Science Practice: Make a table to compare the various gas laws.
	Lab: Charles's Law	
		Calculate relationships between volume and temperature according to Charles's law.
		Science Practice: Analyze and interpret data gathered in an investigation about Charles's law.
	Lab: Boyle’s Law	
		Perform an investigation that demonstrates the relationship between the volume and pressure of a gas.
		Science Practice: Obtain, evaluate, and communicate information gathered in an investigation about Boyle's law.
	The Ideal Gas Law	
		Explain how Avogadro’s law, or principle, can be combined with other gas laws to describe the relationships among pressure, temperature, volume, and number of moles of a gas.
		Solve problems using the ideal gas law.
		State the ideal gas law, which relates pressure, temperature, and volume of an ideal gas.
		Science Practice: Use math to solve ideal gas law problems.
Reaction Rates, Equilibrium, and Energy in Chemical Reactions		
	Reaction Rate	
		Describe collision theory and how it is related to reactions.
		Explain how various factors, including concentration, temperature, and pressure, affect the rate of a chemical reaction.
		Explain the concept of reaction rate.
		Science Practice: Use the collision theory model to explain how reactions happen.
	Lab: Reaction Rate	
		Demonstrate the effects of changing temperature and particle size on the rate of a chemical reaction.
		Develop reasonable conclusions in an investigation about reaction rate and generate explanations for the observed results.
		Science Practice: Plan and perform controlled tests of multiple variables using repeated trials during an investigation about reaction rate.
	Reversible Reactions and Equilibrium	
		Explain dynamic equilibrium.
		Write equilibrium expressions, and use them to calculate the equilibrium constant for reactions.
		Science Practice: Use scientific notation when solving problems to find the equilibrium constant for a reaction.

Unit	Lesson	Lesson Objectives
	Shifts in Equilibrium	
		Use Le Chatelier's principle to predict shifts in equilibrium caused by changes in pressure, concentration, and temperature.
		Use Le Chatelier's principle to predict shifts in equilibrium caused by the addition of a common ion to the system.
		Science Practice: Translate technical information expressed in words about Le Chatelier's principle into a chart.
	Energy	
		Describe the law of conservation of energy.
		Differentiate among the various forms of energy, including kinetic energy, potential energy, chemical energy, and thermal energy.
		Explain that energy can be transformed from one form to another.
		Science Practice: Integrate concepts from both chemistry and physics to analyze energy transformations and the conservation of energy.
	Heat	
		Describe heat flow in terms of the motion of atoms or molecules.
		Distinguish between exothermic chemical processes and endothermic chemical processes.
		Relate temperature to the average molecular kinetic energy.
		Science Practice: Analyze and interpret information about a reaction to classify the reaction as either an exothermic process or an endothermic process.
	Calorimetry	
		Define calorimetry and explain how calorimeters work.
		Differentiate between heat capacity and specific heat.
		Solve problems involving heat flow and temperature changes to calculate the specific heat of a substance.
		Use calorimetry to calculate the heat of a chemical process.
		Science Practice: Perform mathematical calculations involving heat, mass, temperature change, and specific heat.
	Lab: Calorimetry and Specific Heat	
		Demonstrate safe laboratory practices while using a calorimeter.
		Determine the specific heat of a metal using a calorimeter.
		Identify possible sources of procedural and mathematical errors in an experiment.
		Systematically collect, organize, record, and analyze data.
		Science Practice: Precisely follow a multistep procedure to build and use a calorimeter.
	Thermochemical Equations	
		Understand the use of enthalpy in thermochemistry.
		Use thermochemical equations to calculate energy changes (i.e., enthalpy changes) that occur in a chemical reaction.
		Use thermochemical equations to calculate energy changes (i.e., enthalpy changes) that occur in a combustion reaction.
		Science Practice: Examine books and other sources of information to find standard enthalpies of formation to solve thermochemical problems.

Unit	Lesson	Lesson Objectives
Mixtures, Solutions, and Acid-Base Reactions		
	Properties of Water	
		Describe how the structure of water accounts for its polarity.
		Describe the unique role of water in chemical and biological systems.
		Explain why water has unique properties including high surface tension and a high boiling point.
		Science Practice: Explain how the chemistry of water is important to biological systems.
	Mixtures and Solutions	
		Describe heterogeneous mixtures, including suspensions and colloids.
		Describe homogeneous mixtures, such as solutions.
		Identify nonaqueous solutions.
		Identify the components of a solution.
		Science Practice: Build vocabulary by properly using the terms mixture, solution, solute, and solvent.
	Solutions and Solubility	
		Define solubility and differentiate between saturated, supersaturated, and unsaturated solutions.
		Describe the dissolving process on the molecular level.
		Identify factors affecting the rate at which a substance dissolves.
		Investigate factors that influence solubility.
		Science Practice: Interpret, analyze, and make inferences from solubility graphs.
	Lab: Solubility	
		Accurately read the temperature in °C to know how temperature affects saturation.
		Formulate an investigative question to scientifically investigate how temperature affects solubility.
		Investigate how the temperature of a solvent affects the solubility of a solid.
		Science Practice: Plan and carry out an investigation to test factors affecting solubility.
	Properties of Acids and Bases	
		Describe applications of acids and bases.
		Describe the observable properties of acids.
		Describe the observable properties of bases.
		Science Practice: Determine the meaning of the key terms acid and base as they are used in chemistry.
	Arrhenius, Bronsted-Lowry, and Lewis Acids and Bases	
		Describe the Arrhenius definitions of acids and bases.
		Describe the Bronsted-Lowry definitions of acids and bases.
		Describe the Lewis definitions of acids and bases.
		Identify conjugate acids and conjugate bases in a Bronsted-Lowry acid-base reaction.
		Science Practice: Describe how Arrhenius's, Bronsted's, Lowry's, and Lewis's competing interpretations of the same evidence are useful in different ways.

Unit	Lesson	Lesson Objectives
	pH	
		Convert between pH and hydrogen ion concentration, and between pOH and hydroxide ion concentration.
		Convert between pH and pOH, and between hydrogen ion concentration and hydroxide ion concentration.
		Define pH and pOH.
		Describe the self-ionization of water.
		Use the pH scale to characterize the acidity and basicity of solutions.
		Science Practice: Solve scientific problems involving pH using logarithmic functions.
Nuclear Chemistry		
	Types of Radioactive Decay	
		Differentiate between chemical reactions and nuclear reactions.
		Identify types of radioactive decay.
		Science Practice: Translate technical information expressed in words in a text about nuclear radiation into a visual form, such as a table, to compare the different types of radiation.
	Half-Life	
		Calculate the amount of a radioactive substance remaining after an integral number of half-lives have passed.
		Calculate the number of half-lives that have passed given mass data for the radioactive substance.
		Describe what a half-life is.
		Science Practice: Solve scientific problems by substituting quantitative values.
	Lab: Half-Life	
		Collect, organize, and record appropriate data while doing an investigation on half-life.
		Communicate valid conclusions for a investigation modeling half-life.
		Explain how the half-life of a radioactive element is determined.
		Understand the concept of half-life through simulation.
		Science Practice: Develop and use a model for studying half-life.
	Nuclear Fission and Nuclear Fusion	
		Explain and compare fission and fusion reactions.
		Relate the role of nuclear fusion to the production of essentially all elements heavier than helium.
		Science Practice: Justify the need for peer review in science.
	Nuclear Energy	
		Describe how nuclear power plants work.
		Describe the issues surrounding nuclear waste.
		Science Practice: Weigh the merits of using nuclear energy to solve society's need for electrical energy by comparing a number of human, economic, and environmental costs and benefits.

Unit	Lesson	Lesson Objectives
Chemistry in Earth Systems		
	Biological Evidence and the Fossil Record	
		Assess the comparative anatomies among organisms.
		Describe how the fossil record shows common ancestry between organisms.
		Distinguish scientific evidence that supports the theory of evolution.
		Science Practice: Explain the role of scientific argumentation in evaluating the validity of data, claims, hypotheses, and observations.
	Absolute Ages of Rocks	
		Describe how the half-lives of isotopes are used to determine a rock's age.
		Identify how absolute age differs from relative age.
	Early Earth History	
		Describe changes in Earth and its life-forms at the end of the Paleozoic Era.
		Draw conclusions about how species adapted to changing environments in Precambrian time and the Paleozoic Era.
		Identify characteristic Precambrian and Paleozoic life-forms.
	Middle and Recent Earth History	
		Compare and contrast characteristic life-forms in the Mesozoic and Cenozoic Eras.
		Explain how changes caused by plate tectonics affected organisms during the Mesozoic Era.
		Identify when humans first appeared on Earth.
	Weathering and Erosion	
		Compare and contrast weathering and erosion.
		Describe the effects of natural erosion on the environment.
		Distinguish between chemical and physical weathering.
		Explain the impact of artificial erosion on the environment.
		Skills used: Create graph, map, chart.
	The Cycles of Matter	
		Demonstrate the importance of water, carbon, nitrogen, and phosphorus in ecosystems.
		Describe how water, carbon, nitrogen, and phosphorus are cycled through ecosystems.
		Science Practice: Compare the economic, human, and environmental losses to the benefits of a specific scientific example.
	Photosynthesis and Cellular Respiration	
		Compare and contrast the processes of photosynthesis and cellular respiration.
		Illustrate and describe the energy conversions that occur during photosynthesis and respiration.
		Science Practice: Evaluate data to formulate a conclusion.
	Human Impact on the Environment	
		Analyze how human populations affect resources.
		Give examples of human activities that have been beneficial and detrimental to the environment.
		Relate the greenhouse effect to global warming and explain its impact on the environment.
		Science Practice: Give examples of science contributions impacting sustainability.

Unit	Lesson	Lesson Objectives
	What Are Natural Resources?	
		Explain how fossil fuels are formed.
		Explain how natural resources are produced.
		Explain how resource availability is limited by rates of use and renewal.
		Skills used: Making predictions, compare and contrast, researching with technology, making logical connections.
	A History of Global Climate Change	
		Analyze various theories related to global warming.
		Compare current and past global climate trends.
		Describe the effects of greenhouse gases on the atmosphere.
		Explain how long-term global climate shifts impact Earth's ecosystems.
		Skills used: Compare and contrast support and opposition.